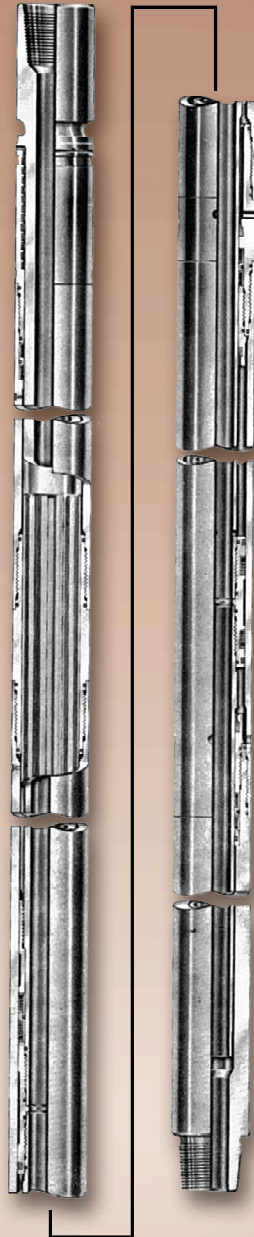


PRESSURE BALANCED DRILLING BUMPER SUB

Instruction Manual 4410



Pressure Balanced Drilling Bumper Sub

Pressure Balanced Drilling Bumper Sub

INDEX

Pressure Balanced Drilling Bumper Sub	
General Description	3
Uses	3
Construction	3
Explanation of Mechanism	3
Operation	3
Maintenance	5
Rig Floor Maintenance	6
Dressing Area Maintenance	6
Disassembly	6
Reassembly	9
Itcolube Filling	10
Specifications and Replacement Parts	14 – 16

The designs and specifications for the tools described in this instruction manual were in effect at the time this manual was approved for printing. National Oilwell Varco, whose policy is one of continuous improvement, reserves the right to discontinue models at any time, or to change designs and specifications without notice or without incurring obligation.

Sixth Printing, September 2005

General Description

The Bowen Pressure Balanced Drilling Bumper Sub is a long stroke bumper sub often called a slack joint. It is engineered to withstand sustained torque through its full five-foot stroke under the most severe drilling operations. The Bumper Sub is 100 percent pressure balanced, which permits free travel through the full stroke unaffected by variations in pump pressure and/or hydrostatic pressure. The bore through the tool permits full circulation at all times.

The Bowen Pressure Balanced Drilling Bumper Sub is approximately 36-feet-long and is available in sizes with minimum outside diameters of 4-3/4, 6-1/4 and 7-3/4 inches. The tool O.D.'s are variable as ordered and each is manufactured with an O.D. that matches the drill collar or tool joint O.D. of the drill string in which it will be used.

Use

The Bowen Pressure Balanced Drilling Bumper Sub is specifically designed for use as a pressure balanced slack joint on offshore well drilling rigs to eliminate bit movement relative to the natural heave produced by wave action of semi-submersible or floating drilling vessels. In addition to providing a slip joint in the drill string, the tool transmits torque to the drill bit and may be used as a bumper jar to free a stuck string. It provides a means for applying a constant load on the drill bit regardless of vessel motion. It is also an excellent safety device, particularly when working in sticky formations, very deep holes or crooked holes, in coring jobs, and when running bits or reamers with restrictive bores.

Construction

Bowen Pressure Balanced Drilling Bumper Subs are manufactured from carefully selected high grade alloy steel. Quality engineering has reduced points of usual high stress concentration which assures long dependable service from each tool. Threaded connections and splines are precision machined and corrosion resistant coatings in various areas reduce wear. The tool has external and internal balance chamber ports located to minimize sand and mud entry and assure in and out flow to wash the chambers clean. To prevent galling of the splines at bearing loads of 100,000 lbs., the spline chamber is filled with Bowen Itcolube anti-gall compound. Various O-rings, seals, packing and wipers located throughout the tool seal in the Itcolube and prevent well fluids from entering where they would damage parts. The low cost, easily replaceable Spline Body is designed to absorb any wear that may occur, therefore reducing spline wear to a minimum on the more expensive Mandrel.

Explanation of Mechanism

The Bowen Pressure Balanced Drilling Bumper Sub is usually located in the drill string above the bit and drill collars in offshore drilling where wave motion affects the operation. Wave action causes it to extend and contract through all or part of its stroke and the splines allow torque to be transmitted into the bit during this motion.

Pressure balancing allows an unvarying downward force to be applied to the bit regardless of the motion or the variation in pressure of well fluids being circulated down through the drill string and returning outside the string. This is accomplished by having internal and external ports in the tool which allow well fluids to enter its balance chambers.

The Lower Balance Body and Upper Washpipe form a chamber having an annular cross-sectional area equal to the cross-sectional area of the Lower Washpipe. Internal fluid pressure, acting on these areas in opposite directions, provides a complete balanced effect with regard to internal pressure.

The Upper Balance Body and Upper Washpipe, along with the Lower Balance Body and Lower Washpipe, form chambers having combined annular cross-sectional areas which are equal to the cross-sectional area of the Mandrel. External fluid pressure, acting on these areas in opposite directions provides a completely balanced effect with regard to external pressure.

It should be noted that these balancing effects are independent of each other and provides a completely balanced condition with any combination of external and internal pressures.

Operation

The Bowen Pressure Balanced Drilling Bumper Sub is usually installed in the drilling string immediately above the drill collars. However, it may also be installed with drill collars above and below.

The following describes operations from floating vessel and semi-submersible type drill rigs. A very general consideration must be given because of the widely variable characteristics both with regard to the type of drill vessel and the climatic and geological conditions that exist world wide.

Operational application will be considered only with regard to use of the Bumper Subs to stabilize bit weight and other bottom-hole operations. For clarity of communication and definition of nomenclature, some description and discussion of terms used that are distinctive and peculiar to floating drilling operations may prove useful:

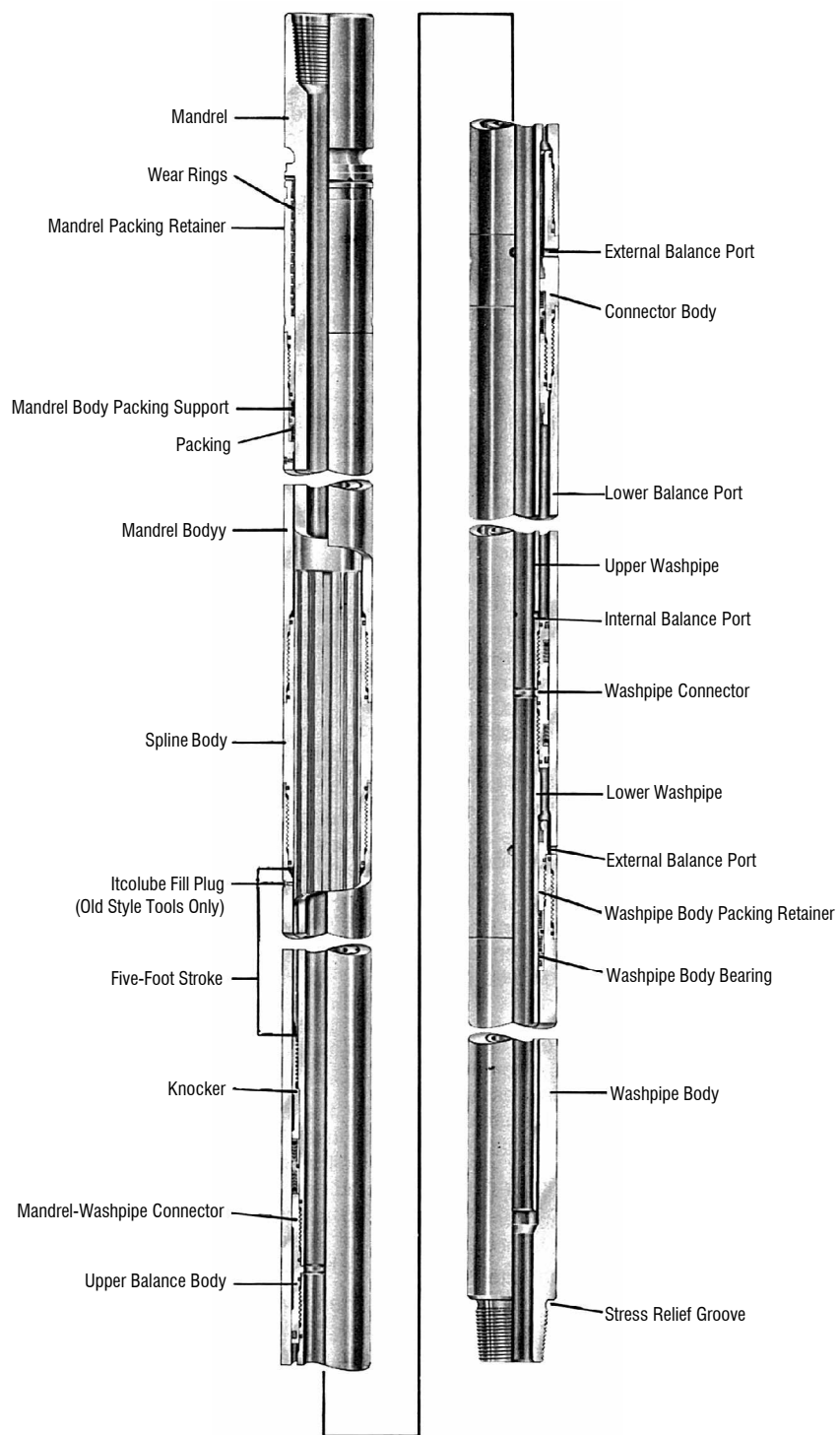


Figure 1
Bowen Pressure Balanced Drilling Bumper Sub

1. **Drilling Drag** — Drilling Drag is the resistance to vertical movement offered by the drill string and drill assembly in the hole. On land rigs, drilling drag generally is a much more static feature of torque buildup required to turn the bit and is not operationally related to hook load, and is not directly keyed to operational function of the automatic driller, weight indicator, geograph, rotary speed, or pump characteristics. However, on floating drilling operations, each motion or “heave” of the vessel causes the drilling drag to become a dynamic force that affects all the drilling parameters related to cutting a bore hole in the earth. Familiar visible land drilling indicators that have always been linear, static, and constant in nature on land drilling operations, become dynamic, variable, and very unreliable and hard to interpret with respect to actual downhole events.

2. **Wave Height** — The total difference between the trough and crest of waves in feet is taken as wave height. Rough water in between waves is described as “seas.”

3. **Heave** — Heave is that vertical reaction of a floating drilling rig to wave motion, and is recorded in feet of vertical displacement of the vessel. Vessel heave is generally some value less than wave height in feet.

4. **Period** — The time between advancing waves that strike a floating vessel is described as “period” and is measured in seconds.

5. **Roll, Pitch, Yaw** — These are motion characteristics that are generally related to the degree of freedom or motion of a drill vessel.

No simple chain of events can occur in a dynamic drilling situation off a floating vessel with the Bumper Sub in the hole. The hook load is not related to drill collar weights in floating drilling operations because of the separation of the drill collar weight by the “freestroke” distance to the Bumper Sub. To allow “drill off” of the bit to progress to the point that the stroke of the Bumper Sub is taken up could allow the heave of the vessel to pick the bit up off bottom. This would, of course, permit the drill torque to be relieved, disturb pumping operations and cause erratic drilling rate due to uneven bit loading. Conversely, if lowering of the drill string is too rapid during bit drill off, the stroke or free travel of the Bumper Sub will be taken up and vessel heave down will permit drill pipe loads to slam down overloading the bit. Thus a very delicate operational balance must be maintained between automatic driller or manual drilling feed and bit drill off. As various formations are encountered offering variable resistance, continues adjustments have to be made at the surface to maintain the drill-off feed bumper jar stroke relationship. Frequently, weight indicator signals are the only indication of where the bit is with respect to the stroke of the Bumper Sub.

Such variable in drilling as formation penetration rate, drilling drag, keyseating, bit dulling, reamer wear and other factors will cause variation requirements in drill line spool-off to make it possible for the lower drill assembly to operate within the stroke of the Bumper Sub.

By making slight frequent adjustments, as indicated, either in the manual or automatic drilling mode, it is possible to keep even loading on the bit and operate within the stroke of the Bumper Sub up to 90% of the drilling time.

Although the above description of drilling events on floating vessels may sound complicated, with modern drilling equipment and competent driller experience and skill, the drilling procedure can be mastered to the point of extremely smooth and safe operation with the Bumper Sub in the hole. The Bumper Sub will make it possible to properly control bit weight and other drilling parameters from a floating drill rig and will allow some conventional hole control methods to be applied.

The O.D. of the Bumper Sub should never be larger than the drill collar O.D. Small O.D. Bumper Subs used in large diameter holes should always be well stabilized in the hole. Extra life can be expected and improved bit penetration may be experienced as well as much more ease in surface control of drilling parameters if the Bumper Sub is properly stabilized.

When two or more Bumper Subs are used together for extending stroke length, their position should be rotated at approximately 100-hour intervals. This will allow the subs to share the stroke characteristics of the drilling assembly and distribute the wear evenly over the total number of tools.

When the long stroke Bumper Subs are used on vessels with high response to wave motion, the heave may be compensated by using extra bumper subs in the string when drilling in high seas or during storm seasons.

Maintenance

There are generally two types of maintenance required for the Bowen Pressure Balanced Drilling Bumper Sub: rig floor maintenance after moderate use or on a short duration job, and dressing area maintenance in an adequately equipped dressing area after prolonged and/or hard use.

Rig Floor Maintenance

After moderate use and when the Bumper Sub is to be kept at the rig, raise the drill string from the well and set the slips when the first set of balance ports rise to shoulder height. Using clean fresh water or a water jet or similar device and when the tool is closed, flush through one port and then another until all the mud is washed from the chamber. Raise the string until the other balance ports are shoulder height and repeat the washing. After this, open and close the tool its full stroke a few times using the draw-works. The sucking in and out of air through the internal balance ports helps purge most of the mud from the chamber.

CAUTION: After use, never leave well mud in the chambers for more than two hours because it jells, becomes difficult to remove and may cause damage when the tool is next used.

Raise the tool out of the slips, wash all mud from the exterior, and if possible, wash the mud from the Mandrel, Washpipe and Washpipe Body. If the tool is to be stored for over two days, a water displacing oil should be sprayed into the balance chambers and over the entire tool to prevent rust.

Dressing Area Maintenance

After prolonged and/or hard use, the Bumper Sub should be removed from the string and a thread protector installed on the Washpipe Body pin. Then it should be taken to an adequate dressing area to be completely disassembled, cleaned, inspected, repaired as required and reassembled.

The following list of tools and pieces of equipment should be obtained before starting maintenance. Most are items usually found in well equipped oil field dressing areas.

- (1) 1-1/2 Ton Lifting Hoist
- (1) Bowen Vise or equivalent
- (2) Support Stands
(Adjustable with Rollers)
- (1) Chain Comealong (1 Ton Capacity)
- (1) 15-foot-long 1/4" Chain
with 1/4" Grab Hooks on each end
- (1) 36-Inch Pipe Wrench
- (1) 60-Inch Pipe Wrench
- (1) Pully and Post secured 15 feet from Vise (A fork lift truck, or equivalent can also be used as a substitute for the post and comealong for pulling-off or pushing-on parts. Bowen does not recommend this procedure because it provides poor control.)

Disassembly

Refer to Figure 2, page 7. The "up end" in the accompanying figures is on the left.

1. With tool in closed position, use hoist and place in Vice clamped on lower end of Lower Balance Body just below the balance ports. Position "up end" of tool in support stand to aid handling. Remove Itcolube Fill Plugs (old style tools only). See Figure 3, page 11.
2. Using large pipe wrench, breakout Washpipe Body (71). Using chain come along attached to post, draw Body off of Lower Washpipe. The Washpipe Packing Retainer, Packing Support and Washpipe Body Bearing are made up to the Body. Set these parts aside for later separation.
3. Relocate tool in Support Stand and Vise to clamp on Connector Body (37). Break out Lower Balance Body (47) and using chain comealong, slide off over Lower Washpipe (59). See Figure 4, page 11. Breakout and remove Washpipe Connector (54) and Lower Washpipe. Set these two parts aside for later separation.
4. Unscrew and remove Washpipe Packing Retainer (45). Relocate tool to clamp on Upper Balance Body (19), just above Connector Body, and break out Connector Body. Slide Connector Body off Upper Washpipe (30). Then remove the Connector Body Packing Support (41) from inside Connector Body.
5. Relocate tool to clamp on Spline Body (16). Break out Upper Balance Body and remove, using chain comealong. This is the longest external member of the tool and may require use of the 15-foot chain around a pulley and pulled with the hoist, instead of the comealong. See Figure 5, page 11. Remove Mandrel Washpipe Connector (26) with Upper Washpipe (30) which is still attached. See these two parts aside for lateral separation. Then remove Mandrel Packing Support (22) and Knocker (20).
6. Relocate tool in Vise to clamp on up end of Mandrel Body (13). Push Mandrel (1) up about one foot and unscrew Mandrel Body until threads are disengaged. This joint has lefthand threads. Pull Mandrel out through top of body. Slide off the Mandrel Body Packing Support (8) and Mandrel Packing Retainer (which have come out of the Mandrel Body with the Mandrel). Relocate in Vise to clamp on Spline body and break out Mandrel Body. This joint also has lefthand threads.
7. Remove remaining part from Vise and pick up Washpipe Body from temporary storage place (see step 2) and clamp in Vise on O.D. next to up end threads. Remove Washpipe Body Packing Retainer (61), Washpipe Body Packing Support (64) and Bearing (67). Clear Vise again, take Washpipe Connector and Lower Washpipe from

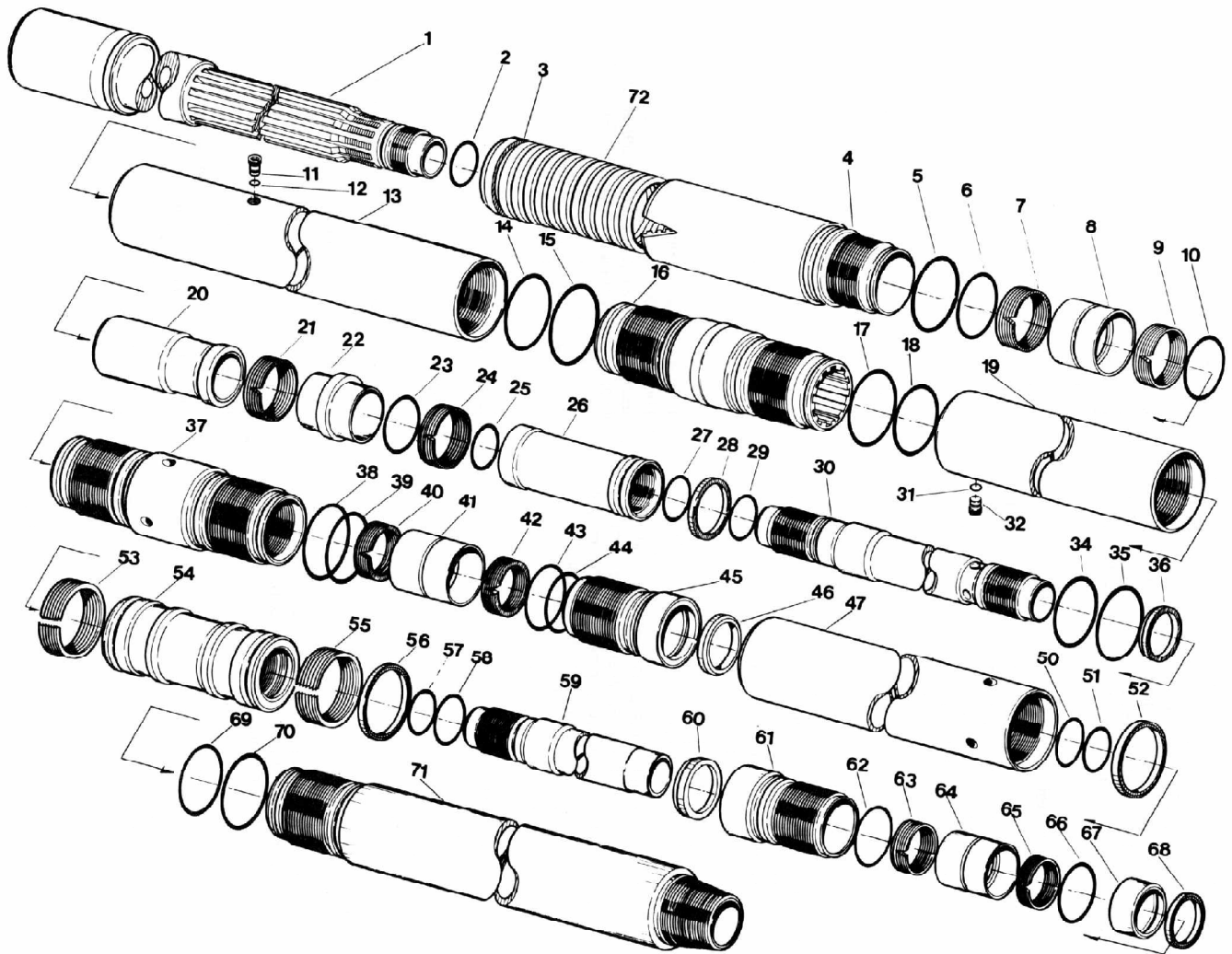


Figure 2
6-1/4" O.D. Tool Shown

Bowen Pressure Balanced Drilling Bumper Sub — 5-Foot Stroke

ITEM	REQ.	PART NAME
1	1	Mandrel
2	1	O-Ring
3	1	Mandrel Packing Retainer Wiper
4	1	Mandrel Packing Retainer
5	1	O-Ring
6	1	O-Ring
7	1 set	Mandrel Body Pkg. Support Pkg. Set
8	1	Mandrel Body Pkg. Support
9	1 set	Mandrel Body Pkg. Support Pkg. Set
10	1	O-Ring
11	1	Fill Plug (If Needed)
12	1	O-Ring (If Needed)
13	1	Mandrel Body
14	1	O-Ring
15	1	O-Ring
16	1	Spline Body
17	1	O-Ring
18	1	O-Ring
19	1	Upper Balance Body
20	1	Knocker
21	1 Set	Mandrel Pkg. Support Pkg. Set
22	1	Mandrel Pkg. Support
23	1	O-Ring
24	1 Set	Mandrel Pkg. Support Pkg. Set
25	1	O-Ring
26	1	Mandrel-Washpipe Connector
27	1	O-Ring
28	1	Mandrel-Washpipe Connector Wiper Seal
29	1	O-Ring
30	1	Upper Washpipe
31	1	O-Ring (If Needed)
32	1	Fill Plug (If Needed)
34	1	O-Ring
35	1	O-Ring
36	1	Connector Body Wiper
37	1	Connector Body

ITEM	REQ.	PART NAME
38	1	O-Ring
39	1	O-Ring
40	1 set	Connector Body Pkg. Support Pkg. Set
41	1	Connector Body Pkg. Support
42	1 set	Connector Body Pkg. Support Pkg. Set
43	1	O-Ring
44	1	O-Ring
45	1	Connector Body Pkg. Retainer
46	1	Connector Body Pkg. Retainer Wiper (4-3/4" O.D. Tool has 2 Wear Rings) Not Shown
47	1	Lower Balance Body
50	1	O-Ring (Not Req'd. on 4-3/4" O.D. Tool)
51	1	O-Ring
52	1	Washpipe Connector Wiper
53	1 set	Washpipe Connector Pkg. Set
54	1	Washpipe Connector
55	1 set	Washpipe Connector Pkg. Set
56	1	Washpipe Connector Wiper
57	1	O-Ring
58	1	O-Ring
59	1	Lower Washpipe
60	1	Washpipe Body Pkg. Retainer Wiper
	1	Washpipe Body Pkg. Retainer Wear Ring (4-3/4" O.D. Tool Only) Not Shown
61	1	Washpipe Body Pkg. Retainer
62	1	O-Ring
63	1 set	Washpipe Body Pkg. Support Pkg. Set
64	1	Washpipe Body Pkg. Support
65	1 set	Washpipe Body Pkg. Support Pkg. Set
66	1	O-Ring
67	1	Washpipe Body Bearing
68	1	Washpipe Body Bearing Wiper Seal
69	1	O-Ring
70	1	O-Ring
71	1	Washpipe Body
72	11	Mandrel Packing Retainer Wear Rings

temporary storage (see step 3), and clamp in vise on Connector. Using small wrench on large raised diameter, break out and remove Lower Washpipe.

Completing disassembly of major parts allows access to all O-Rings, Packing, Wipers and Wear Rings which then may also be removed. Discard all worn Wipers, Packing, O-Rings and Wear Rings. Clean all parts thoroughly and inspect carefully for damage that may require rework or replacement. The Mandrel Splines and Spline Body should be visually inspected for presence of burred edges and metal particles. If more than 1/16 of wear shows between splines on the Spline Body and splines on the Mandrel, the Spline Body should be replaced.

If all parts are kept clean and if threads and polished surfaces are not damaged, they may be used indefinitely, with specified servicing.

Reassembly

Prior to reassembly, the parts should all be thoroughly cleaned and dried. Make sure all parts are in good condition. Coat them with a thin oil, if not already done, and lay them out on clean cloths or Kraft paper. The tool will normally require a complete set of packing each time it is redressed. Depending upon usage and conditions, this may be required after 500 to 1,000 operating hours.

1. The complete packing set consists of Packing, O-Rings, Wear Rings, Wipers, and Polypak Seals. All these may be installed onto or into Packing Supports, Packing Retainers and other parts prior to making up the main parts. It is of the utmost importance that the Packing and Wipers be installed in the proper way. If the "V" of the Packing cross section is installed

opposite to the way shown, the tool will not operate. See exploded view Figure 2 on page 7 for positions of Wipers, O-Rings, and Wear Rings. See Figure 6 on page 12 for positions and part numbers of Packing. About 10 to 12 lbs. of Bowen Itcolube is required for each dressing. It should be noted that no other lube is satisfactory for this tool in areas of severe wear such as the Spline Chamber. As the tool is assembled, coat all joints generously with Bowen Itcolube. An adequate supply of cup grease should also be on hand.

2. Install Washpipe Body (71) in Vise. Insert Washpipe Body Bearing (67), with its Wiper Seal (68), and Washpipe Body Packing Support (64), with its Packing and O-Ring, into the Body. Spread cup grease on the Packing. Then make up Washpipe Body Packing Retainer (61).

NOTE: On 4-3/4" O.D. tool, in addition to the Wiper, there is a wear ring installed on Washpipe Body Packing Retainer. Remove these parts from vise and set aside temporarily. Install Washpipe Connector in vise and make up Lower Washpipe (59) to it, using small wrench on large raised diameter. Remove these parts from Vise and set aside temporarily.

3. Install Spline Body (16) in Vise with its lefthand threads towards up end. Make up down end of Mandrel Body (13) to up end of Spline body. This joint has lefthand threads.

4. Relocate in Vise to Clamp on Mandrel Body. Install Mandrel Body Packing Support (8) with its Packing and O-Ring into the "up end" of the Mandrel Body. Spread cup grease on the Packing. Take the Mandrel Packing Retainer with its Wiper (30) and Wear Rings (72). Spread cup grease on the inside of the Retainer and Wear Rings.

Make up Mandrel Packing Retainer to Mandrel Body, stopping 1/2 to 1 inch before completely shouldering up. This holds the packing in place but does not compress it.

NOTE: This joint also has lefthand Threads. Take Mandrel (1) and heavily grease the Splines with Itcolube and the smooth seal diameter with cup grease. At the "up end," using hoist to lift the Mandrel, gently slide it into Mandrel Body so that the Mandrel slowly enters the Splines in Spline Body. Before closing Mandrel shoulder against Mandrel Packing Retainer, completely make up Retainer to Mandrel Body.

5. Relocate in vise to clamp on Spline Body. Apply cup grease to the I.D. of Knocker (20) and make up on Mandrel. File down any burrs on the O.D. of Knocker. Apply a thick coating of Bowen Itcolube on exposed Splines of the Mandrel. Work Mandrel back and forth through its full stroke length a few times and then open tool until Knocker is against Spline Body. Install Mandrel Packing Support (22) with its Packing and O-Ring. Apply cup grease to the I.D. of the support so it can slide easily onto Mandrel. Make up Mandrel-Washpipe Connector (26) to Mandrel. File down any burrs on the O.D. of the Connector. Note that the end of the Mandrel-Washpipe Connector with the Wiper Seal is the "down end."

6. Install Upper Washpipe (30) into Mandrel-Washpipe Connector. Coat the O.D. of the Knocker, Mandrel Packing Support Package, Mandrel-Washpipe Connector, and Upper Washpipe with cup grease. Using chain comealong and/or the 15-foot chain around the vise and pulled with the hoist, slide Upper Balance Body (19) over Connector onto Mandrel and make up to Spline Body. See Figure 7, page 13.

7. Slide Connector Body, with its Wiper, along Upper Washpipe and make up to Upper Balance Body. Relocate tool in support stand and vise to clamp down end of Upper Balance Body. Slide connector Body Packing Support (41), with its Packing and O-Ring and Connector Body Packing Retainer (45), with its Wiper, along Washpipe and into Connector Body. Make up Retainer to Connector Body.

NOTE: On 4-3/4" O.D. tool, there are two (2) Wear Rings instead of a Wiper installed in the Connector Body Packing Retainer.

8. Take Washpipe Connector (54) from temporary position, which already has Lower Washpipe installed (see step 2), and make it up to Upper Washpipe. File down any burrs on the O.D. of the Connector.

NOTE: On newer style 4-3/4" O.D. tools, there is only one O-Ring at this connection. Before installing Lower Balance Body which forms a balance chamber, spray a water displacing oil over the Upper Washpipe from the internal balance ports up to the wiper of the Connector Body Packing Retainer. Then, using chain comealong, slide Lower Balance Body (47) over Washpipe Connector and make up to Connector Body. See Figure 8, page 13.

9. Relocate tool in Support Stand and Vise to clamp on end of Lower Balance Body. Take Washpipe Body (71) from temporary position which already has Bearing, Washpipe Body Packing Support and Washpipe Body Packing Retainer installed (see step 2), and using chain comealong, slide it over Lower Washpipe and make up to Lower Balance Body. See Figure 9, page 13.

10. Spray a water displacing oil inside the two (2) remaining chambers through the external balance ports. Work Mandrel back and forth over its full stroke length and spray more of the oil into the chambers. Before installing Fill Plugs (not required on newer style tools) in Upper Balance Body, fill with Bowen Itcolube.

Itcolube Filling

(Not required on new style tools)

1. Position tool on support stand Vise with a fill plug hole pointing up and install Adapter (66681) in hole. The tool may be in the open or closed position.
2. Fill Grease Gun Assembly (66682) with Bowen Itcolube and attach its hose to Adapter.
3. Using Gun, completely fill spline chamber with Itcolube until it begins to come out of other Fill Plug Hole. Occasional refilling of Gun will be necessary.
4. When full, remove Gun and Adapter, and install O-Rings (12 and 31) and Fill Plugs (11 and 32) into Fill Plug holes.

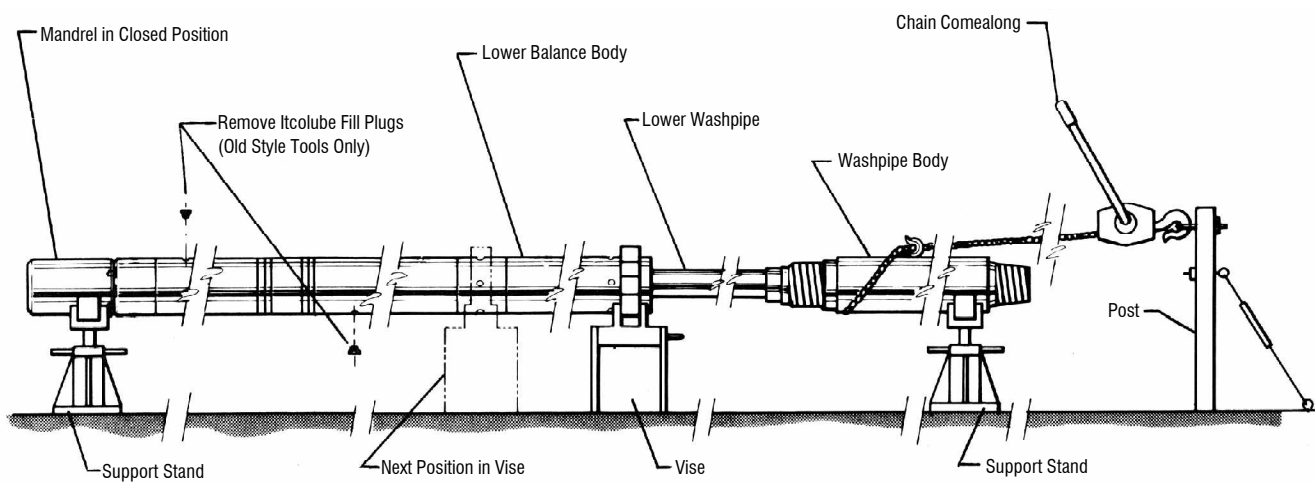


Figure 3

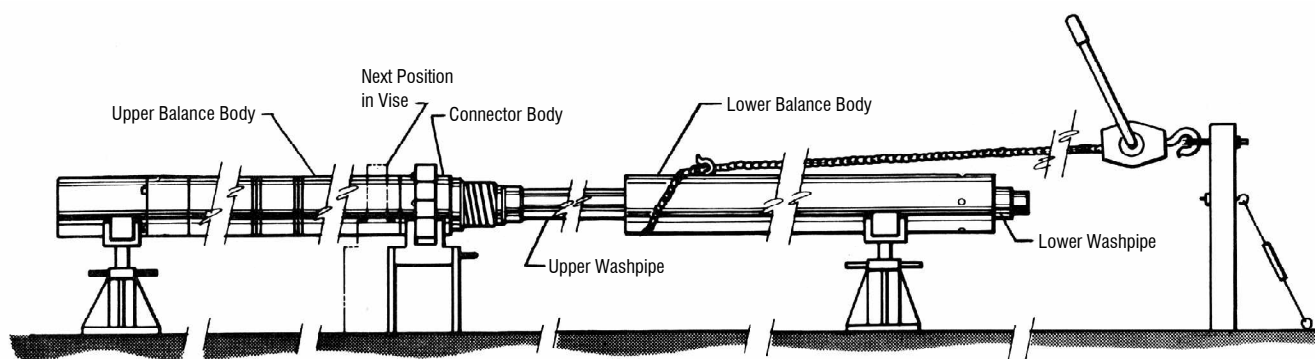


Figure 4

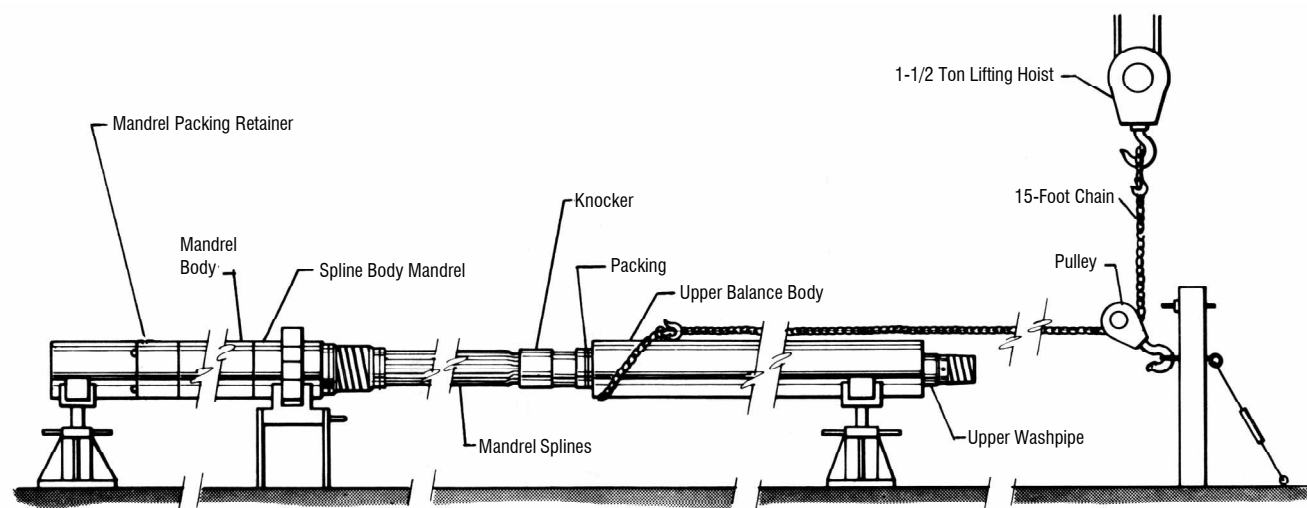


Figure 5

NOTE: Soft Seal Ring, indicated here in black, must be positioned as shown.

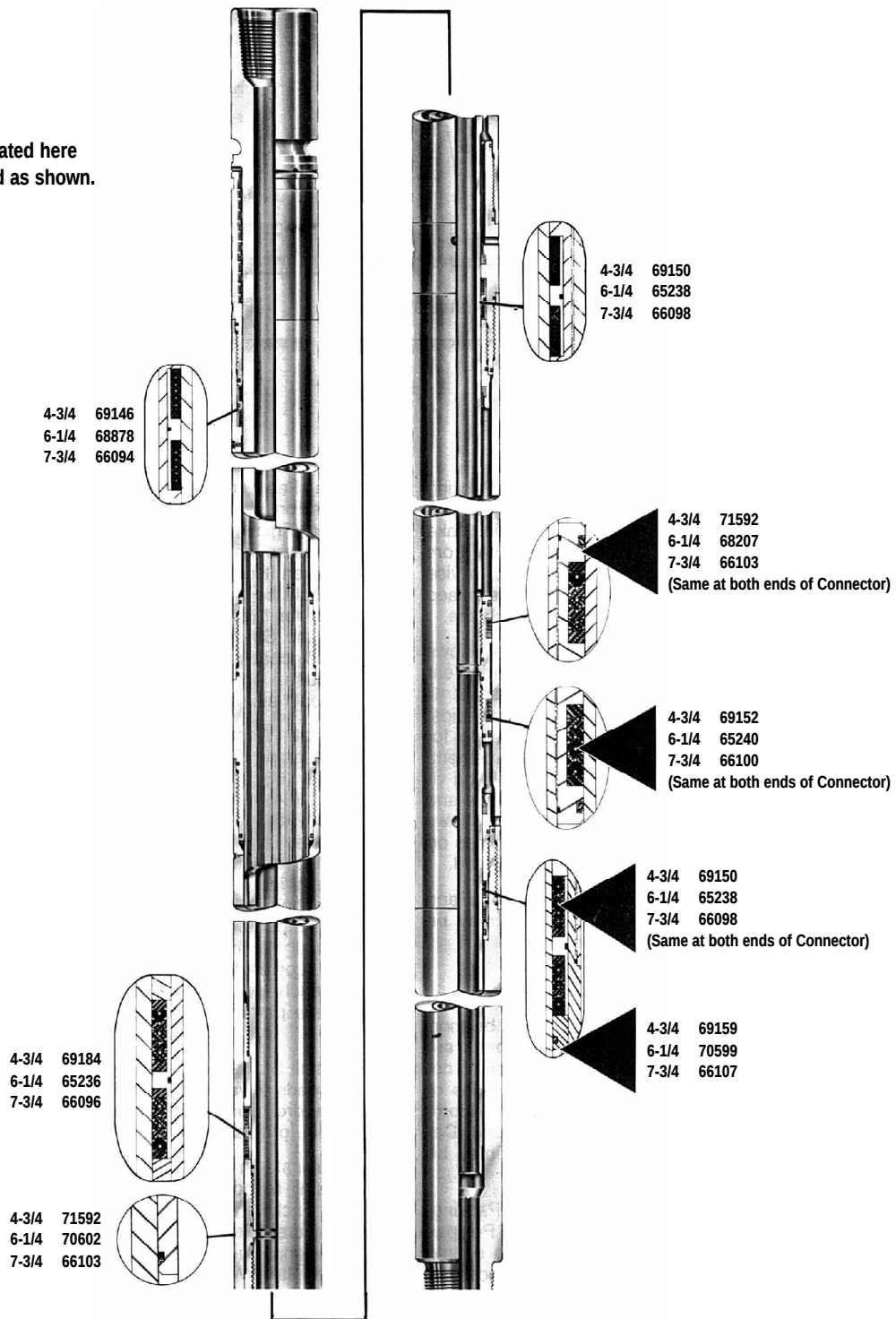


Figure 6
Wiper and Packing Installation "V" Position
Including Size with Part Number

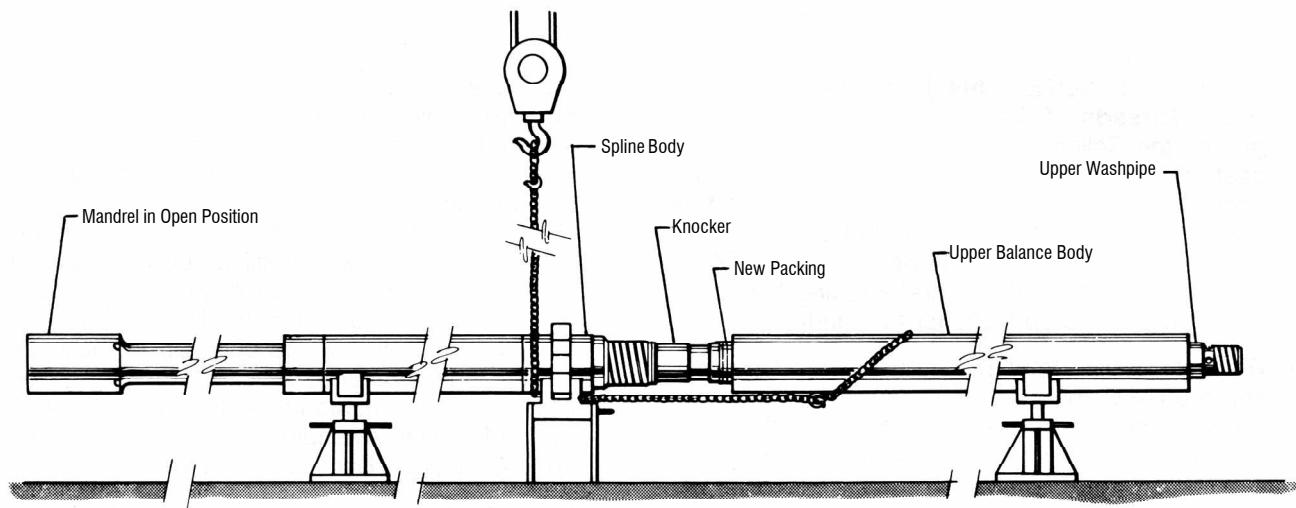


Figure 7

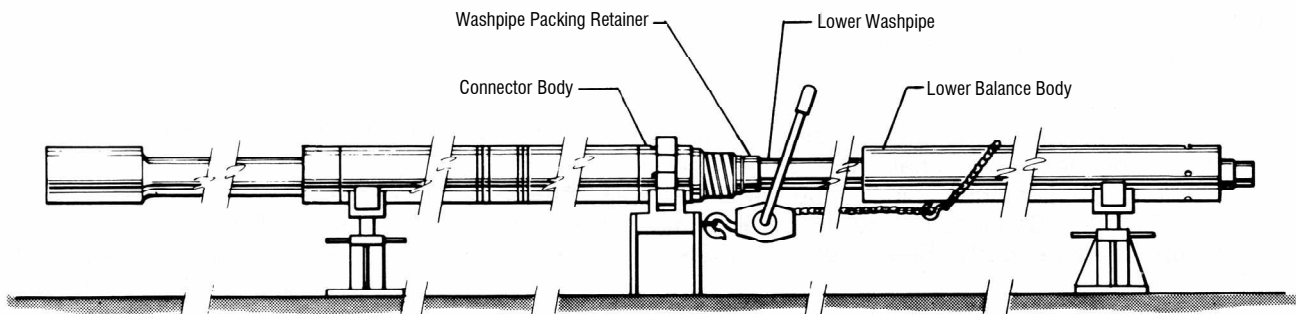


Figure 8

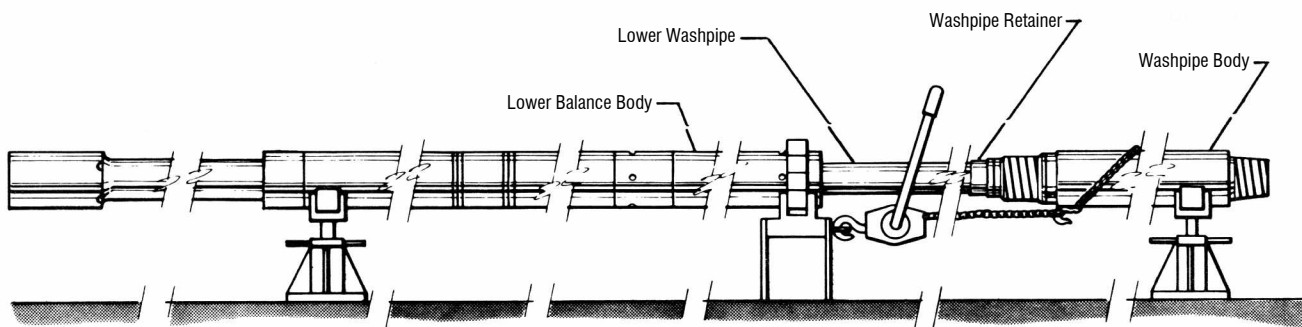


Figure 9

Bowen Pressure Balanced Drilling Bumper Subs

Maximum Outside Diameter In Inches		4 ³ / ₄	6 ¹ / ₄	7 ³ / ₄
Connections (Customizing Available)		3 ¹ / ₂ I.F.	4 ¹ / ₂ I.F.	6 ⁵ / ₈ REG.
I.D. In Inches		2	3	3 ¹ / ₂
Stroke In Feet		5	5	5
Torsional Yield (Ft. - Lb.)		43,000	90,000	189,000
Tensile Load Capacity		625,000 Lbs.	863,000 Lbs.	1,800,000 Lbs.
Length In Feet		33 ¹ / ₂	36	36
Complete Assembly	Part No.	68243	69780	66080
	Weight	1500 Lbs.	2700 Lbs.	4100 Lbs.

Replacement Parts

Mandrel	Part No.	69132	69781	66081
	Weight	400	705	1065
Mandrel Body	Part No.	69134	69783	66083
	Weight	154	280	400
Spline Body	Part No.	69135	69784	66084
	Weight	40	76	130
Knocker	Part No.	69137	69786	66086
	Weight	9	14 ¹ / ₂	12
Upper Balance Body	Part No.	69136	69785	66085
	Weight	55	398	580
Lower Balance Body	Part No.	69139	69788	66088
	Weight	195	256	336
Washpipe Body	Part No.	69140	69789	66089
	Weight	307	522	844
Mandrel - Washpipe Connector	Part No.	69138	69787	66087
	Weight	14	25	27
Upper Washpipe	Part No.	69141	69790	66090
	Weight	55	105	167
Connector Body	Part No.	69145	70146	66106
	Weight	44	85	144
Washpipe Body Bearing	Part No.	69153	69796	66101
	Weight	1	3 ¹ / ₂	3
Mandrel Packing Retainer Wiper	Part No.	69154	71531	66102
	Weight	1 ¹ / ₂	1 ¹ / ₂	1 ¹ / ₂
Connector Body Wiper	Part No.	69156	69831	66104
	Weight	1 ¹ / ₂	1 ¹ / ₂	1 ¹ / ₂
Connector Body Pkg. Retainer Wear Ring (2 Req'd.)	Part No.	69157	—	—
	Weight	1	—	—
Connector Body Pkg. Retainer Wiper	Part No.	—	69831	66104
	Weight	—	1 ¹ / ₂	1 ¹ / ₂
Washpipe Body Pkg. Retainer Wiper	Part No.	69156	69831	66104
	Weight	1 ¹ / ₂	1 ¹ / ₂	1 ¹ / ₂
Washpipe Body Pkg. Retainer Wear Ring	Part No.	69157	—	—
	Weight	1	—	—
Washpipe Connector	Part No.	69142	69791	66091
	Weight	12	28	60
Lower Washpipe	Part No.	69143	69792	66092
	Weight	41	77	99

Bowen Pressure Balanced Drilling Bumper Subs

Washpipe Body Pkg. Retainer	Part No.	69144	69793	66093
	Weight	6 1/2	10	32
Mandrel Body Pkg. Support Pkg. (2 Req'd.)	Part No.	69146	68878	66094
	Weight	1/4	3/4	1
Mandrel Body Pkg. Support	Part No.	69147	68877	66095
	Weight	2	1	1 1/4
Mandrel Pkg. Support Pkg. (2 Req'd.)	Part No.	69148	65236	66096
	Weight	1/2	3/4	1
Mandrel Packing Support	Part No.	69149	65237	66097
	Weight	2	2	10
Connector Body Pkg. Support Pkg. (2 Req'd.)	Part No.	69150	65238	66098
Washpipe Body Pkg. Support Pkg. (2 Req'd.)	Weight	1/2	3/4	1 1/4
Connector Body Pkg. Support	Part No.	69151	69794	66099
Washpipe Body Pkg. Support	Weight	1	1 1/2	3
Washpipe Connector Packing (2 Req'd.)	Part No.	69152	65240	66100
	Weight	1/2	3/4	1 1/4
Connector Body Pkg. Retainer	Part No.	69158	69793	66093
	Weight	7	10	32
Mandrel Packing Retainer	Part No.	71904	71530	71922
	Weight	31	55	101
Mandrel Pkg. Retainer Wear Ring (11 Req'd.)	Part No.	71905	71532	71923
	Weight	1/4	1/4	1/2
Mandrel-washpipe Connector Wiper Seal	Part No.	715902	70602	66103
	Weight	1/4	1/4	1/2
Washpipe Connector Wiper Seal (2 Req'd.)	Part No.	71592	68207	66103
	Weight	1/4	1/4	1/2
Washpipe Body Bearing Wper Seal	Part No.	—	70599	66107
	Weight	—	1/2	1/2
Washpipe Body Bearing Wiper	Part No.	69159	—	—
	Weight	1/2	—	—
Mandrel Pkg. Retainer O-ring	Part No.	30-21	30-32	30-40
	Weight	—	—	—
Mandrel Body Pkg. Support O-ring	Part No.	30-19	30-29	30-38
	Weight	—	—	—
Fill Plug O-ring (If Needed) (2 Req'd.)	Part No.	27-1	27-1	27-1
	Weight	—	—	—
Spline Body O-ring (Small) (2 Req'd.)	Part No.	30-18	—	30-37
	Weight	—	—	—
Small Lower Spline Body O-ring	Part No.	—	30-27	—
	Weight	—	—	—
Small Upper Spline Body O-ring	Part No.	—	30-29	—
	Weight	—	—	—
Large Lower Spline Body O-ring	Part No.	—	30-30	—
	Weight	—	—	—
Large Upper Spline Body O-ring	Part No.	—	30-32	—
	Weight	—	—	—
Spline Body O-ring (Large) (2 Req'd.)	Part No.	30-20	—	30-39
	Weight	—	—	—
Mandrel Pkg. Support O-ring	Part No.	30-9	30-18	30-23
	Weight	—	—	—
Small Mandrel-washpipe Connector O-ring (2 Req'd.)	Part No.	30-7	30-16	30-21
	Weight	—	—	—
Large Mandrel-washpipe Connector O-ring (2 Req'd.)	Part No.	30-9	—	30-23
	Weight	—	—	—
Mandrel O-ring	Part No.	—	30-16	—
	Weight	—	—	—

Bowen Pressure Balanced Drilling Bumper Subs

Upper Washpipe O-ring	Part No.	—	30-16	—
	Weight	—	—	—
Small Connector Body O-ring (2 Req'd.)	Part No.	30-18	30-27	30-37
	Weight	—	—	—
Large Connector Body O-ring (2 Req'd.)	Part No.	30-20	30-30	30-39
	Weight	—	—	—
Connector Body Pkg. Support O-ring	Part No.	30-12	30-20	30-28
	Weight	—	—	—
Washpipe Body Pkg. Support O-ring	Part No.	30-12	30-20	30-28
	Weight	—	—	—
Connector Body Pkg. Retainer O-ring	Part No.	30-14	30-22	30-31
	Weight	—	—	—
Washpipe Body Pkg. Retainer O-ring	Part No.	30-14	30-22	30-31
	Weight	—	—	—
Small Washpipe Connector O-ring (2 Req'd.)	Part No.	30-7	30-16	30-20
	Weight	—	—	—
Large Washpipe Connector O-ring (2 Req'd.)	Part No.	—	30-17	30-22
	Weight	—	—	—
Large Upper Washpipe Connector O-ring (Not Used On Newer Tools)	Part No.	568-145	—	—
	Weight	—	—	—
Large Lower Washpipe Connector O-ring	Part No.	30-9	—	—
	Weight	—	—	—
Small Washpipe Body O-ring	Part No.	30-18	30-27	30-37
	Weight	—	—	—
Large Washpipe Body O-ring	Part No.	30-20	30-30	30-39
	Weight	—	—	—

Extra

O-ring Packing Set	Part No.	69737	69797	66538
	Weight	2	2	3
Complete Packing Set	Part No.	69736	69795	66108
	Weight	3	3	4

Required Accessories (For Old Style Tools)

Fill Plug	Part No.	329	329	329
	Weight	1/4	1/4	1/4
	Quantity	2	2	2
Adaptor	Part No.	66681	66681	66681
	Weight	1/4	1/4	1/4
Lever Grease Gun	Part No.	66682	66682	66682
	Weight	5	5	5
Flexible Hose	Part No.	69688	69688	69688
	Weight	2	2	2
Quick Change Portable Pump	Part No.	70532	70532	70532
	Weight	15	15	15
Hand Gun Hose Assembly	Part No.	70533	70533	70533
	Weight	2	2	2
Standard Button Head Fitting	Part No.	70534	70534	70534
	Weight	1/4	1/4	1/4
Grease Injector Exhaust Silencer	Part No.	70535	70535	70535
	Weight	1/4	1/4	1/4
Dog Collar	Part No.	69750	69751	69692
	Weight	7	9	15

* The indicated outside diameters are the minimum allowable. Outside diameters that match the drill collar or tool joints which will be run in conjunction with the tool should be used.

How To Order: Specify:

- | | | |
|--|----------------------------|----------------------|
| 1. Name and number of Assembly or Part. | Recommended Spares | |
| 2. Size and Type of connection if other than standard. | 1. Six of each packing set | 3. Six of each wiper |
| 3. Outside Diameter. | 2. Four of each O-ring | 4. Two Fill Plugs |

Corporate Headquarters

10000 Richmond Avenue
Houston, Texas 77042
United States
Phone: 713 346 7500
Fax: 713 346 4493

Alaska
4111 Ingra
Anchorage, Alaska 99503
United States
Phone: 907 563 5253
Fax: 907 561 0071

California
4117 Atlas Court
Bakersfield, California 99308
United States
Phone: 661 395 0165
Fax: 661 328 1827

Louisiana
108 Nova Drive
Broussard, Louisiana 70518
United States
Phone: 337 839 2400
Fax: 337 839 2211

190 Thompson Road
Houma, Louisiana 70363
United States
Phone: 985 851 1111
Fax: 985 851 1117

Mississippi
2930 Industrial Blvd.
Laurel, Mississippi 39440
United States
Phone: 601 649 8671
Fax: 601 649 8673

New Mexico
#14 CR 5860
Farmington, New Mexico 87401
United States
Phone: 505 326 4303
Fax: 505 326 4304

North Dakota
3202 1st Avenue West
Williston, North Dakota 58801
United States
Phone: 701 774 0091
Fax: 701 774 0092

Oklahoma
3800 Thomas Road
Oklahoma City, Oklahoma 73179
United States
Phone: 405 677 2484
Toll Free: 877 760 1711
Fax: 405 677 2457

Texas
1249 Commerce Road
Alice, Texas 78332
United States
Phone: 361 664 8013
Fax: 361 664 0462

8411 Irvington Boulevard*
Houston, Texas 77022
United States
Phone: 713 691 7800
Fax: 713 691 7807

2810 Highway 135 North
Kilgore, Texas 75662
United States
Phone: 903 984 2553
Fax: 903 984 7170

10720 West I-20 East
Odessa, Texas 79765
United States
Phone: 432 563 1173
Fax: 432 563 1182

30444 Southwest Freeway
Rosenberg, Texas 77471
United States
Phone: 281 341 5365
Fax: 281 344 1986

Utah
1553 East Highway 40
Vernal, Utah 84078
United States
Phone: 435 789 0670
Fax: 435 789 6568

West Virginia
Route 2, Murphy Run Road
Clarksburg, West Virginia 26301
United States
Phone: 304 622 4303
Fax: 304 623 2174

Wyoming
1283 N. Derrick Drive
Unit 1, Box 2
Casper, Wyoming 82604
United States
Phone: 307 237 3100
Fax: 307 237 2546

Canada
9120 – 34A Avenue
Edmonton, Alberta T6E 5P4
Canada
Phone: 780 702 5209
Fax: 780 463 2348

3550 93 Street*
Edmonton, Alberta T6E 5N3
Canada
Phone: 780 944 3929
Fax: 780 430 0760

1100 540 5th Avenue SW (Mailing)
1010 540 5th Avenue SW (Office)
Calgary, Alberta T2P 0M2
Canada
Phone: 403 250 8000
Fax: 403 294 5790

England
2 Isbourne Way
Winchcombe
Cheltenham
Glos, GL54 5NS
England
Phone: 44 (0) 1242 603975
Fax: 44(0) 1242 602614

Dubai
Nr. R/A 13, Daimler Chrysler Street
P.O. Box 61490
Jebel Ali Free Zone
Dubai
UAE
Phone: 971 4 8838776
Fax: 971 4 8838795

Indonesia
Cilandak Commercial Estate Unit 105
Jl. Raya Cilandak KKO
P.O. Box 7541
Jakarta, 12560
Indonesia
Phone: 62 21 782 6088
Fax: 62 21 782 6086

Scotland
10 Kirkton Avenue
Pitmedden Road Industrial Estate
Dyce, Aberdeen AB21 0BF
Scotland
Phone: 441 224 334800
Fax: 441 224 723034

Singapore
9 Tuas Avenue 5
Singapore, 639335
Singapore
Phone: 65 68611566
Fax: 65 68610728

Germany
Edesser Straße 1
31234 Edemissen Berkhöpen
Postfach 31232
Germany
Phone: 49 5176 97670
Fax: 49 5176 9767 22

* Denotes Manufacturing and Engineering facilities

Downhole Solutions

Drilling Solutions

Engineering and Project Management Solutions

Lifting and Handling Solutions

Production Solutions

Supply Chain Solutions

Tubular and Corrosion Control Solutions

Well Service and Completion Solutions